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Review on Epidemiology of Strongylosis

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Abstract

Strongylosis is one of the most important internal parasitic diseases of equines caused by nematodes of strongylidae family affecting more than 80% equines in the world. The horse is host to a great number of gastrointestinal parasite species, of which nematodes of the family Strongylidae, commonly called strongyle nematodes or strongyles, are the most important. These parasites are ubiquitous and live as adults in the large intestine of equids.

The main characteristic feature of strongyle nematodesis a well-developed buccal capsule, the shape and size of which are important for species identification. Strongyle nematodes of equids (horse, donkey, zebra) are classified into the subfamilies Strongylinae and Cyathostominae, sometimes categorized as large and small strongyles, respectively.

Strongylus vulgaris is one of the large strongly and the most prevalent and pathogenic parasites of equines. Large strongyles show major pathogenesis that is encompasses verminous arteritis, damage of visceral organs, embolism or thrombosis leading to death and is mainly attributed to migrating larvae of parasites. The larvae of Strongylus species are causes to large nodules in the wall of caecum and colon with a considerable hemorrhage and the nodules become rupture and release the worm into the lumen of the intestine. In the heavy burdens bleeding can occur and leads to the death of the animals. Inspite of substantial improvements in understanding the life cycle of strongyles and adopting latest diagnostic techniques and implementing the most modern treatment and control measures, the disease is still prevalent and could not be eradicated from any part of the world.

The current strategy engaged in seasonal use of anthelmintics is the key to arrest the disease and overcome anthelmintic resistance. Using a mixed grazing system and removal of all horse feces from the fields twice weekly is highly effective for the control of strongyles.

Keywords: Epidemiology • Equines strongylosis • Strongyle vulgaris • Anthelmintics

Introduction

The population of the equine in the world is 122.4 million. In the distribution pattern, 98% of all donkeys, 97% of all mules and 60% of all horses are found in the developing countries. The number of equines in Africa is in the range of 17.6 million comprising 11.6 million donkeys, 2.3 million mules and 3.7million horses.

Equines (donkeys, mules and horses) play an important role as working animals in many parts of the world, employed for packing, riding, carting and ploughing. Equine power is vital for both rural and urban transport system where is cheap and provides the best alternatives in places where the road network is insufficiently developed, the terrain is rugged and mountainous and in the cities where narrow streets prevent easy delivery of merchandise. In areas away from roads, many people use mules and donkeys to transport food and other supplies to villages [1].

Donkeys and mules experience long working hours and difficult conditions. These animals are often engaged in work for long hours and when get free, they are left to browse and feed on garbage. These have the potential to affect negatively their welfare and quality of life they decrease the activity, production and productivity in the animals mainly in the reduction of body weight or failure to gain weight or even increase the mortality in acute case [2].

Strongylidae are classified into two subfamilies, Strongylinae and Cyathostominae, sometimes categorized as large and small strongyles respectively. The main characteristic feature of strongyle

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nematodes is a well-developed buccal capsule, the shape and size of which are important for species identification. By comparing DNA sequences, it has been shown that the genera with small cylindrical buccal capsules are likely to have evolved from those with large buccal capsules.

The diagnosis of strongyle is by examination of feces for the detection of the strongyle egg, fecal culture for identification of strongyle larvae and per rectal examination reveals aneurysm of cranial mesenteric artery. Equines are treated with anthelmintic drugs to eliminate adult strongyles from the large intestines and to prevent excessive contamination of pastures with eggs and L3s. The effective control programs of the large strongyles are applying a strategic treatment and improve pasture management. The most commonly mixed species of Strongyle infections are found in horses.

Among the gastro-intestinal nematodes of horses, large Strongyle infection are most devastating and were reported with an infection rate of 58.5%.

However, the overall prevalence of Strongylus nematodes remained high in herds where anthelmintic have not been used. Intrinsic factors like age and gender are found to affect the prevalence of Strongyle infection and egg excretion.

In Ethiopia there is a less modern transportation system in rural areas and some cities. Equines are the most use full means of transporting both industrial and farm products in rural and cites.

Helminthe parasites were playing a great damage in equine species and have high economic negative feedback. When a lot of equines graze in free pasture causes contamination of equine strongylosis and facilitate prevalence of the disease. Due to this render their performance in control, management system, healthcare and housing system of equine species [3].

Therefore, the objectives of this review are:

- To review the characteristics of large strongly.
- To highlight the epidemiology, life cycle, pathogenesis and clinical sign of Equine strongylosis.
- To indicate the possible treatment and control options.

Literature Review

Etiology of equine Strongylosis

Morphology: Strongylus worms have a reddish color due to ingested blood. *Strongylus vulgaris* is up to 25 mm long, S. edentatus up to 40 mm and *S. equinus* up to 50 mm. Female worms are longer than male worms. As for other roundworms, the body of these worms is covered with a cuticle, which is flexible but rather tough. The cuticle of these species shows a circular striation. The worms have a tubular digestive system with two openings, the mouth and the anus. All species have a characteristic well formed, rather spherical buccal capsule equipped with basal teeth to cut the host's tissues (Figure 1).

Figure 1. Close-up of *Strongylus vulgaris* mouthparts.

They feed on blood and tissues of the organs they migrate through. These worms are so-called plug feeders, i.e. they cut out small portion of the tissue in the organs where they stay or are migrating through. They also have a nervous system but no excretory organs and no circulatory system, i.e. neither a heart nor blood vessels. The female ovaries are large and the uteri end in an opening called the vulva. Males have a copulatory bursa with two spicules for attaching to the female during copulation. The eggs are ovoid, rather small (45 x 80 micrometers), thin-shelled and usually contain a 16 cell morula [4].

Life cycle of equine Strongylosis

All species of Strongyle nematode have direct life cycles but are somewhat complicated as they involve somatic migration of larval stages. There are significant differences in number of eggs in female uteri in various Strongylus species. The egg number differs 50–100 times between species. Eggs are laid by adult female Strongyle nematode and passed in the faeces into the external environment where they hatch to the first stage larvae (L1s), at 12℃–39℃ with adequate moisture. The minimum temperature for eggs to hatch is 7℃–8℃. From the egg on the ground per pasture, L1 emerges which grows and molts to L2 and then to the L3 stage.

The L3 is the infective stage and under optimal summer conditions it requires about ten days to two weeks to develop from the time the egg is passed. L3s retain an outer protective sheath and are more resistant to chilling and dehydration than the L1s and L2s. Dehydration can prevent L3s from leaving the faeces and gaining contact to herbage. Most larvae climb no higher than 10 cm from the soil surface and can move 15 cm horizontally and during rain L3s migrate from the faeces to the surrounding herbage most efficiently. After ingestion of L3 by the host, they pass to the small intestine, remove their external covering and initiate the internal phase of development. Removal of protective covering depends upon the stimuli from physiological/biochemical conditions in the gut of the host. Larvae of large Strongyle nematode emerge from the sheath through an anterior cap, whereas larvae of small Strongyle nematode escape via a longitudinal slit in the region of the oesophagus. Removal of outer covering at 38˚C within 3 hours using an artificial intestinal fluid comprising trypsin, pancreatin, sodium bicarbonate and sodium dithionite has been achieved experimentally [5].

Internal phase of large Strongyle nematode larval development encompasses a somatic migration, whereas those of small Strongyle

nematode burrow into the glands in the caecum and colon and become encysted with no further migration. In the submucosa next molting occurs i.e., L4 on about day 4 or 5. Working against the flow of blood, the L4s gradually move up the arterial system of the intestine. By the 8th day larvae have reached the cecal and ventral colic arteries. When these larger arteries are reached, the route of migration is marked by a twisty thread of fibrin on the intima and by day 14 larvae may be found in mural thrombi. The ileo-cecal and cranial mesenteric arteries are reached between 11 and 14 days. The traveling advance attains its climax by the 19th day at which time larvae may be found in almost any part of the arterial system but are always most abundant in arteries close to the origin of the cranial mesenteric artery.

The molting to the fifth stage (L5) occurs as early as 9 days and by 120 days. At this stage most larvae are pre-adults measuring up to 18 mm long. *S. vulgaris* larvae tend to remain in the arterial site until they molt to the fifth stage, though many fourth stage larvae are apparently swept away before the last molt occurs. Larval size and the thrust from the flow of blood are important factors in the separation of larvae from arterial lesions. The pre-adult larvae reach the small arteries on the serosal surface of the large intestine and terminal small intestine (Figure 2).

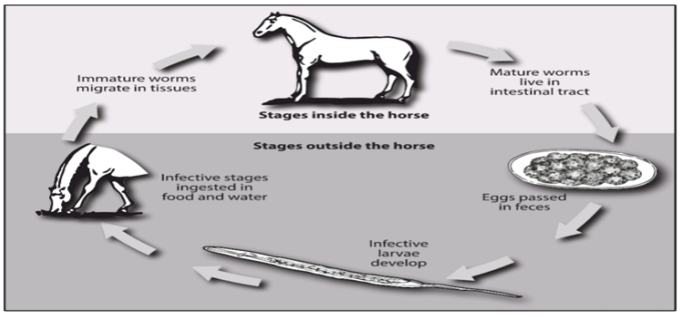

Figure 2. Strongyle life cycle.

Epidemiology

Strongylus is a common disease of horses through the world and cause death when control measures are neglected. In areas with cold winter and mild summer, egg deposition peaks in spring and remains high over summer. Temperatures are suitable for larval development and massive contamination of infective larval may occur in late summer and early summer and early autumn when young susceptible horses are present *S.vulgaris* larval can occur in winter. If the summers are hot and dry at only a small proportion of strongyle eggs develop to larval and these may be short lived but continual re infection keeps pasture contamination high. The onset of disease following ingestion of large number of larval depends on the maturation period of the parasite in the host and whether it is immature or adult stage that is pathogenic [6].

Pathogenesis

Strongylus vulgaris is the most pathogenic of the large Strongyle nematode because of the prolonged (at least 4 months) and extensive migrations through the mesenteric arterial system and its branches before returning to be mature in the cecum and colon. Larval migrations cause damage to the smooth endothelial surfaces of arteries, providing a focus for clot formation. These clots (thrombi) are inflammation and a progressive thickening of the arterial walls. The damage caused by large and small Strongyles is attributed to larval stages. Small Strongyles have small buccal capsules and feed superficially on the mucosa.

Intussusuption are seen occasionally colic may be also be caused mesenteric artery on the thickened cranial mesenteric artery on the mesenteric plexus. The larvae of *S.vulgaris* are important because of their location in artery primarily the anterior mesenteric artery which supplies blood to the large intestine. Their attachment to the lining of the vessel causes roughened lining of vessel produce an ideal site of for fibrin and leucocytes to be taken out of the blood stream thrombi. Both large and small stronglyles damage the lining of intestinal wall at the attachment. As they wander from place to place abandoned are may ulcerate. Hemorrhage or become infected by bacteria. Infections see to be more severing in clots and young horse enough worms will produce anemia edema digestive disturbance and emaciation [7].

Clinical signs

The prepatent periods (the time from infection until eggs are detectable in faeces) for members of this genus vary from 6 months for *S. vulgaris* to 10-12 months for *S. edentatus*. There is poor hair coat, impaired performance, weight loss, anemia, persistent low grade fever, verminous arteritis and colic related to *S. vulgaris.* Ill-thrift to sudden death, diarrhea and anorexia often take place. High infection rate with Strongyle parasites may result in a stumpy performance and reduced life probability of working equines. Changes in hematological values include reduction in Total Erythrocyte Count (TEC) and Packed Cell Volume (PCV), reduced hemoglobin concentration and eosinophilia [8].

It is generally accepted that mucosal feeding adults of all three Strongylus species can have significant effects on infected horses although there appear not to be any clinical signs that can be specifically attributed to them. General clinical signs of pale mucous membranes, poor weight gains and even weight loss combined with dull, staring coats are seen in horses infected with large Strongylus. However, these clinical signs are generally seen in most parasitic infections of the digestive tract.

The "wormy horse" is generally a poor performance and poor looking, a description that is often described as "unthrifty". Horses like this are now relatively uncommon in the United States because of the wide use (some would say the overuse) of anthelmintic and the acceptance of parasite control programs by veterinarians and the horse-owning public. Anemia, emaciation, poor coat and poor performance are frequently attributed to large Strongylus while in the intestine.

Diarrhea is more common sign in small Strongyle infection than with large Strongyle nematode. These clinical signs are related to the feeding habits of adult worms which grasp a piece of mucosa with their large mouths and digest it, a process that produces considerable

bleeding at the bite site and results in formation of an ulcer. Necropsies show that there are many more ulcers than the actual number of adult large Strongyle nematode in the cecum and colon, a finding that suggests that these worms feed, then move to a fresh site. It also implies that their primary source of food is mucosal tissues and that blood is ingested only as part of the mucosal meal. This means that the large Strongyle nematode are more accurately described as mucosal feeders than blood suckers [9].

Fever in *S. vulgaris* infection is attributed to tissue damage or a toxic substance elaborated by larvae. The steadiest change in early S. vulgaris infection would result a rapid increment in total White Blood Cell (WBC) counts. These values rise sharply during the first three weeks to levels of 17,000 to 22,700/mm^3. Eosinophils values will increase after the second week and demonstrate little change in acute infection. Increments in serum total protein and globulin fractions occur as early as the first week following infection. Thrombus formation can block arteries, causing infarction of intestinal walls and/or intermittent lameness and is commonly associated with clinical signs of marked pyrexia, anorexia, severe colic and death [10].

Diagnosis

Symptoms are not of value for diagnosis. Diagnosis has usually relied on the use of the method of fecal flotation. Since it is not possible to distinguish between Strongyle eggs of different species morphologically, fecal samples are cultured to allow the development to L3s, which may be collected for study and then the species can be easily identified. A method for detecting mucosal larval stages would be valuable in the diagnosis of larvae. A copro-antigen ELISA has shown promise with moderate to good diagnostic sensitivity and specificity as well as a positive correlation with worm numbers [11].

Change in the blood picture associated with S. vulgaris is not unlike that seen in bacterial infections. Alterations in blood biochemical and haematological parameters can be detected in a proportion of infected horses. Hypoalbuminaemia is a common finding in naturally infected horses, which is probably due to the increased permeability of the intestines. A rise of β-globulin in serum has also been reported in natural infections. A marked reduction of serum fructose amines (glycated serum proteins) has been reported for horses with experimental cyathostomin nematode infection [12].

It is almost impossible to distinguish between the eggs of the three Strongyle species. This usually requires coproculture to isolate the larvae, which is rather laborious. Research to develop accurate and easy-to-use diagnostic tools have not yet resulted in a commercially available test kit. Diagnosis is primarily based on clinical history, clinical signs of the disease and detection of Strongyle eggs in the faeces of affected animal mainly through direct smear method (Table 1).

SN	Prevalence	Country (area) in Ethiopia
1	1	Wonchi,Oromia
2	1	Highland of wollo province, Amahara
3	1	Dugdabora, oromia
4	0.982	Western highland of oromia
5	0.877	Gondar,Amahara

Table 1. The distribution of equine strongylosis.

Prevention and control

Prevention by routine deworming of horses is unnecessary in all regions during the 6-month period after infection that comprises the unfavorable season for Strongyle transmission. During this interval, environmental conditions largely prevent new parasites from developing. Even if horses have high egg counts during that period, relatively few of those eggs can develop into adults. Therefore, the goals of parasite control are being accomplished by the climate and compound treatment is not required. Since small numbers of infective larvae may have grave effects on foals thus mares in foal or newly foaled should be regularly examined for Strongyle eggs and treated with suitable anthelmintics. Climatic influences cannot effectively clean pastures from one grazing season to the next [13].

The use of herbal compounds as anthelmentics against strongylosis is not yet to be explored. An important measure to reduce the risk of infection is to avoid overstocking, because if too many animals share the same pastures, horses will rather eat grass contaminated by manure, which increases the risk of ingesting infecting larvae. Ideally each animal should be allocated 2 to 3 acres (0.8 to 1.2 hectares) of land. If feasible, too humid pastures should be drained, the dryer the pasture, the lower the survival of infective larvae and the lower the risk of infection for the horses. Frequent manure removal is also recommended and pastures should not be fertilized with fresh manure. Water tanks should regularly be cleaned and grazing close to them must be avoided. Being wet and frequently visited they are likely to be highly contaminated with infective larvae [14].

To prevent infestations indoors, stable hygiene is crucial. They must be regularly cleaned, manure has to be removed daily and the bedding must be changed regularly. Humidity has to be kept as low as possible, e.g. with adequate ventilation. Alternate grazing with livestock (cattle, sheep) that are not susceptible to Strongylus infection may be considered as well, but livestock can carry other parasites that affect horses. Horses coming into a farm must be always checked for pre-existing infections (e.g. through adequate

fecal examination) or treated with a broad-spectrum anthelmintic before they are allowed to share pastures and premises with other horses. In case of doubt quarantine measures must be considered.

Treatment

Usually, equines are treated with anthelmintic drugs to eliminate adult Strongyles from the large intestines to prevent excessive contamination of pastures with eggs and L3s.

Thiabendazole has been widely used and several other drugs have been developed or approved for use in adult horses, including benzimidazole, tetrahydropyrimidines and organic phosphorus compounds [15].

Currently, there are three main classes of commonly-used drugs, categorized by their mode of action: the benzimidazoles (e.g. thiabendazole, cambendazole, fenbendazole and oxibendazole), pyrantel and the macrocyclic lactones e.g. ivermectin and moxidectin.

In the 1990's, treatment intervals practiced for adult horses were 8 weeks for ivermectin and 4-6 weeks for other anthelmintics.

Many combinations of macrocyclic lactones (abamectin, ivermectin, moxidectin), including ivermectin combined with pyrantel (tetrahydropyrimidine) and ivermectin combined with praziquantel (pyrazinoisoquinolin derivative), a pharmaceutically formed generic paste containing ivermectin 4% were tested for their effectiveness to control gastrointestinal nematodes of horses.

Alike formulations of ivermectins had different efficacies calculated by reduction of EPG [16]. Stages of efficacy of the tested drugs varied against *S. edentatus, S. equinus* and *S. vulgaris*. The generic paste (ivermectin 4%) was less effective than the conservative drugs.

The efficacy of oxafex, ivomec and farbenda has been established with 94.7, 98 and 81% respectively on day l4-post medication. On day 28th post medication it was 100%, 96%and 86%, respectively.

Nowaday, it is recommended to reduce the treatment intensity significantly to holdup further development of anthelmintic resistance. In severe enteropathy the administration of nonsteroidal anti-inflammatory agent is also required. Single intravenous dose of 0.6 mg/kg body weight meloxicam once a day recommended for horses.

There is general agreement that the traditional treatment at frequent intervals should be abandoned and that parasite control be maintained with far fewer anthelmintics [17-19].

Conclusion

Equines are important animals for the life system of developing countries especially in Africa. These animals particularly used for transportation system. Equines provide unlimited services for man, so the equines are the subject of routine frequent neglect and maltreatment. Strongyle infection in equines is found to be widely prevalent and should be considered as one of the important disease of equines; particularly the large strongyles are the most important parasites of equines and more common in an untreated equines and exertinga significant economic impact when they are raised. The large strongyle infections are also common in contaminated environments. These parasites will continue to be the most damaging parasite helminthes in the developing country.

Based on the above conclusions the following recommendations are forwarded:

- Strategic treatment and improved pasture management must be practiced to prevent excessive pasture contamination.
- Any new animals must be isolated from a treated group for 48 hrs-72 hrs before being introduced to the group and must be receive anthelmintics.
- Equines must be kept separately in relation to housing and grazing.
- It is advised that there should be equine health promotion program.
- Supported by government.

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